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CASE REPORT | ENDOSCOPY

Pneumopericardium Complicating Per-Oral Endoscopic Myotomy Due to Inadvertent Use of Air Instead of Carbon Dioxide

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ABSTRACT

Per-oral endoscopic myotomy (POEM) is a relatively novel endoscopic technique for the treatment of achalasia. POEM has been shown to have outcomes comparable to those with Heller myotomy, but it is less invasive and has fewer complications. A 72-year-old man with progressive solid and liquid dysphagia underwent POEM, but soon after the procedure went into cardiac arrest; spontaneous circulation returned after 10 minutes of CPR. He was subsequently found to have tension pneumopericardium as a result of the inadvertent use of air instead of carbon dioxide during the procedure. He had a prolonged hospitalization that required an extended stay in the medical intensive care unit. Although rare, POEM can lead to critical, life-threatening complications.

INTRODUCTION

Per-oral endoscopic myotomy (POEM) is a safe and effective transluminal surgical procedure via a natural orifice, and it is used primarily for treatment of esophageal motility disorders, including achalasia.[1] In recent studies, it's efficacy has been shown to be similar to that of Heller myotomy, and POEM is associated with fewer complications and shorter recovery time.[2,3] Despite being minimally invasive, it can potentially lead to critical and life-threatening complications, including the rare complication of pneumopericardium and subsequent cardiac arrest due to inadvertent use of air instead of carbon dioxide during the procedure.

CASE REPORT

A 72 year-old-man with a past medical history of diabetes mellitus, hypertension, and hyperlipidemia presented with complaints of a several-year history of progressively worsening dysphagia to both solids and liquids with every meal, as well as regurgitation, nocturnal cough, and episodes of choking. A barium swallow showed tapering of the distal esophagus with proximal esophageal dilation. An esophagogastroduodenoscopy revealed tightness at the gastroesophageal (GE) junction. A high-resolution esophageal manometry showed findings consistent with esophagogastric junction outlet obstruction.

Under general anesthesia, a therapeutic scope was advanced to the lower esophagus after the patient was intubated. There was significant retention of fluid noted in the lower esophagus. This was suctioned, and the lumen was lavaged with sterile water to examine the mucosa. An Erbe Hybrid Knife (HybridKnife®, T-type, Erbe USA,

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Figure 1. Chest x-ray showing pneumomediastinum and pneumopericardium.

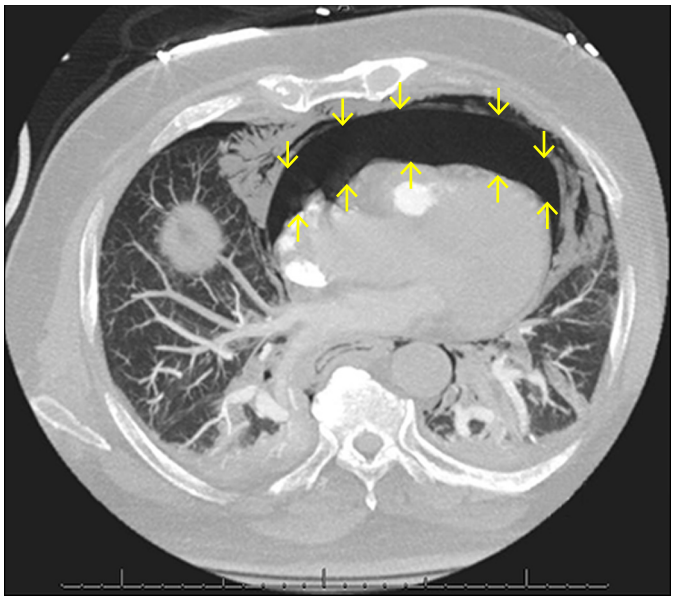

Figure 2. Computed tomography of the chest showing massive pneumopericardium (arrows) causing cardiac tamponade and pneumomediastinum.

Marietta, Georgia) was used to make a submucosal cushion and mucosal incision 15-cm proximal to the GE junction, which allowed the tip of the scope into the submucosal space. Dissection was continued with the tunnel extended past the GE junction about 3 cm into the stomach. Myotomy was intended to begin 3 cm below the mucosal incision site and extended caudally.

Approximately 40 minutes into the procedure, just as we began the myotomy, the patient became hypotensive and went into pulseless electrical activity cardiac arrest requiring cardiopulmonary resuscitation (CPR). After 10 minutes of CPR, he converted to ventricular tachycardia, whereby he received electrical cardioversion with subsequent return of spontaneous circulation. He went into cardiogenic shock, requiring ionotropic drugs. Once stabilized, the incision site made for POEM was closed by clipping, and the myotomy was aborted.

The patient was sent for a stat chest x-ray and computerized tomography (CT) scan of the chest, given concern for pulmonary embolism. It was discovered that ambient air had been used for insufflation instead of carbon dioxide. The stat chest x-ray showed pneumopericardium (Figure 1), and the chest CT revealed extensive pneumomediastinum and pneumopericardium (Figure 2). An emergent bedside pericardial drain was placed with nearly 250 mL of air removed, resulting in immediate improvement in hemodynamics.

He had a prolonged and eventful hospital course complicated by aspiration pneumonia; cardiogenic shock with multi-organ failure, including shock liver and acute kidney injury requiring hemodialysis; atrial fibrillation; and a drug reaction to piperacillin/tazobactam with eosinophilia and systemic symptoms (DRESS syndrome). As the patient improved, a repeat POEM was offered. He subsequently underwent a successful POEM during this hospitalization, less than five weeks after the initial attempt, with nearly complete resolution of his symptoms related to swallowing.

DISCUSSION

Despite being a generally safe procedure, POEM can lead to life-threatening complications. Trace amounts of gas in the mediastinum, pleural, or peritoneal spaces is a frequent finding on post-POEM imaging studies and does not constitute a complication. The most frequently reported complications with POEM include mucosal perforation, subcutaneous emphysema, pneumoperitoneum, pneumothorax, pneumomediastinum, and pleural effusion.[1]

This case is the only one with a serious complication in a series of 108 POEM procedures performed at our institution. As performance of POEM becomes routine and success without complications becomes the rule, one should not let their guard down. The settings of the scope and the electrosurgical system should be confirmed before all cases. Although use of CO_2 is a standard practice in POEM procedures, inadvertent use of air can lead to life-threatening complications. It would be prudent to include the use of low-flow CO_2 in the "Time Out" checklist to potentially avoid complications in the future. In this case, the endoscopy unit was powered down and restarted, and the fact that the system returned to the high-flow air insufflation setting was overlooked. We routinely keep the CO_2 flow very low.

A similar case in which CO_2 was used for insufflation hypothesized that there was a small pericardial defect that resulted in tension capnopericardium and resultant cardiac arrest.[4] Although never detected on imaging, including on a preoperative echocardiogram, this may be the mechanism by which our patient developed his complication. Alternatively, this may have been related only to the high-flow air insufflation. Notably, the patient in the previous case report had immediate improvement of hemodynamics after CPR coupled with an advanced cardiac life support protocol for 10 minutes; that patient did not require intervention with pericardiocentesis, which supports the case for tension capnopericardium.[4]

Endoscopic CO_2 insufflation is used because it is rapidly absorbed compared to air; it is also associated with less pain and recovery time as well as reduced risk of mediastinal emphysema and gas embolization. Air insufflation has been clearly associated with complications of pneumomediastinum and pneumoperitoneum.[5] Had CO_2 been used instead of air for insufflation, we might have prevented this complication or at the very least had a much quicker recovery.

In conclusion, tension pneumopericardium or capnopericardium should be looked for in patients who experience sudden hemodynamic instability during the POEM procedure, especially when a tension pneumothorax or peritoneum is not obvious. Although POEM is less invasive and is associated with lower incidence of intra- and postoperative complications, rare, life-threatening, adverse events may occur. We recommend against using air insufflation for the POEM procedure.

DISCLOSURES

Author contributions: All authors wrote the article. A. Mathew is the article guarantor.

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